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PATENT ABSTRACTS OF JAPAN

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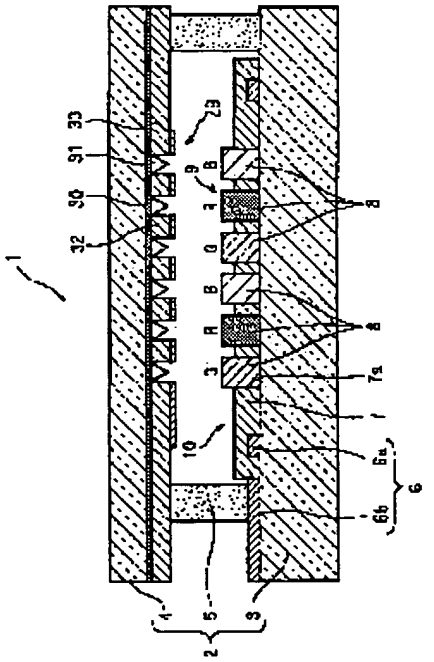
(54) ANODE SUBSTRATE FOR LIGHT EMITTING ELEMENT AND MANUFACTURING METHOD THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce an amount of gas brought into a tube, improve life by increasing a degree of vacuum, and to increase light emitting intensity by eliminating absorption and reflection by an ITO film.

SOLUTION: An FED 1 comprises an envelope 2 wherein outer peripheries of a cathode substrate 4, on which a field emission type cathode 29 is formed, and an anode substrate 3 are sealed with a spacer member 5 therebetween, and the inside of the envelope is retained in a vacuum state. On the anode substrate 3, an anode electrode 6, which comprises a frame-like part 6a for surrounding a display area, and a belt-like part 6b which is continued from the frame-like part 6a and drawn out to an end of the substrate 3, are formed. On the substrate 3, a black matrix layer 7, which covers the frame-like part 6a of the anode electrode 6 and has an opening 7a in a position as a light emitting part in a display area, is formed from a graphite material. Inside of the opening 7a of the black matrix layer 7 wherein the surface of the substrate 3 is exposed, dot-like phosphor layers 8 are attached and formed.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The anode substrate for light emitting devices which is characterized by providing the following and from which the interior constitutes a part of aforementioned envelope of the light emitting device which has the envelope held at the vacua Substrate the anode which consists of graphite material which has opening in the position which makes the light-emitting part in a viewing area, and was formed on the aforementioned substrate -- the black matrix layer which served as the conductor The fluorescent substance layer by which covering formation was carried out into the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes
[Claim 2] The anode substrate for light emitting devices which is characterized by providing the following and from which the interior constitutes a part of aforementioned envelope of the light emitting device which has the envelope held at the vacua Substrate Band-like anode wiring formed on the aforementioned substrate so that it might be pulled out from a viewing area to the edge of the aforementioned substrate the anode which consists of graphite material which has opening in the position which a part covers the aforementioned anode wiring and makes the light-emitting part in the aforementioned viewing area, and was formed on the aforementioned substrate -- the black matrix layer which served as the conductor The fluorescent substance layer by which covering formation was carried out so that the aforementioned black matrix layer might be touched in the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes
[Claim 3] The anode substrate for light emitting devices which is characterized by providing the following and from which the interior constitutes a part of aforementioned envelope of the light emitting device which has the envelope held at the vacua Substrate The frame formed on the aforementioned substrate so that a viewing area might be surrounded Anode wiring which consists of the band-like section formed on the aforementioned substrate so that it might be pulled out to the edge of the aforementioned substrate succeeding this frame the anode which consists of graphite material which has dot-like opening in the position which covers the aforementioned frame of the aforementioned anode wiring, and makes the light-emitting part in the aforementioned viewing area, and was formed on the aforementioned substrate -- the black matrix layer which served as a conductor, and the fluorescent substance layer by which covering formation was carried out at the shape of a dot into the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes
[Claim 4] The anode substrate for light emitting devices according to claim 2 or 3 to which the aforementioned anode wiring is characterized by the bird clapper from a transparent electric conduction film or a metal membrane.
[Claim 5] The anode substrate for light emitting devices given in any of the claims 1-3 characterized by anode driver voltage being 1-7kV they are.
[Claim 6] The manufacture method of the anode substrate for light emitting devices characterized by providing the following that the interior constitutes a part of aforementioned envelope of the light

emitting device which has the envelope held at the vacua the anode which has opening in the position which forms the light-emitting part in a viewing area on a substrate -- the process which forms the black matrix layer which served as the conductor by graphite material The process which carries out covering formation of the fluorescent substance layer into the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes so that the aforementioned black matrix layer may be touched

[Claim 7] The manufacture method of the anode substrate for light emitting devices characterized by providing the following that the interior constitutes a part of aforementioned envelope of the light emitting device which has the envelope held at the vacua The process which forms anode wiring in band-like by the conductive thin film so that it may be pulled out from a viewing area to the edge of the aforementioned substrate on a substrate the anode which has opening in the position which a part covers the aforementioned anode wiring and makes the light-emitting part in the aforementioned viewing area -- the process which forms the black matrix layer which served as the conductor on the aforementioned substrate by graphite material The process which carries out covering formation of the fluorescent substance layer into the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes

[Claim 8] The manufacture method of the anode substrate for light emitting devices characterized by providing the following that the interior constitutes a part of aforementioned envelope of the light emitting device which has the envelope held at the vacua The frame which encloses a viewing area on a substrate The process which forms anode wiring by the conductive thin film so that it may be pulled out to the edge of the aforementioned substrate succeeding this frame the anode which has dot-like opening in the position which covers the aforementioned frame of the aforementioned anode wiring, and makes the light-emitting part in the aforementioned viewing area -- the process which forms the black matrix layer which served as the conductor on the aforementioned substrate by graphite material The process which carries out covering formation of the fluorescent substance layer at the shape of a dot into the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes

[Claim 9] The manufacture method of the anode substrate for light emitting devices according to claim 7 or 8 characterized by forming the aforementioned anode wiring by the transparent electric conduction film or the metal membrane.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the anode substrate for light emitting devices used for light emitting devices, such as field emission form display (FED:Field Emission Display), a fluorescent display (VFD), a high-pressure luminescence cell, and large-sized display (huge TRON), and its manufacture method.
[0002]
[Description of the Prior Art] The plan of the anode substrate of the former [drawing 5] and drawing 6 are the expansion sectional side elevations of FED which used the anode substrate of drawing 5 . In addition, it is omitting about the light-emitting part 27, i.e., the black matrix layer in drawing 6 , and the fluorescent substance layer 28 of the shape of a dot matrix formed in a viewing area in drawing 5 .
[0003] FED21 shown in drawing 6 has the envelope 22 of the shape of a thin shape panel by which the interior was made the high-vacuum state. an envelope 22 sets and meets the anode substrate 23 and the cathode substrate 24 in a minute interval -- making -- the periphery portion of both the substrates 23 and 24 -- a spacer -- it has structure which prepared and sealed the member 25 (for example, sealing agent which consists of adhesives, such as a low melting glass) The transparent electric conduction film (henceforth an ITO film) 26 which consists of ITO (Indium Tin Oxide) which is the multiple oxide of indium oxide and tin is formed in the inside of the anode substrate 23 of an envelope 22.
[0004] the rectangular anode with which the viewing-area left hand lay which shows the ITO film 26 with an alternate long and short dash line was also formed width in the shape of solid one a little as shown in drawing 5 -- a conductor -- 26a and this anode -- it consists of anode wiring 26b which is the band-like cash-drawer electrode pulled out by the edge of the anode substrate 23 from conductor 26a the anode of the ITO film 26 -- a conductor -- in the viewing area of the front face of 26a, as shown in drawing 6 , the black matrix layer 27 which consists of graphite material which has matrix-like opening 27a is formed As shown in drawing 6 , in opening 27a which the ITO film 26 of the black matrix layer 27 exposes, the fluorescent substance layer 28 of the shape of a dot of R (red), G (green), and B (blue) is put. and the above-mentioned anode -- a conductor -- an anode electrode is constituted by 26a, anode wiring 26b, and the fluorescent substance layer 28
[0005] As shown in drawing 6 , the field emission form cathode 29 is formed in the inside of the cathode substrate 24. the cathode with which the field emission form cathode 29 was formed in the inside of the cathode substrate 24 -- a conductor 30 and a cathode -- the emitter 31 of the cone configuration prepared in the conductor 30, and the gate electrode 32 prepared at the nose of cam of an emitter 31 by approaching -- having -- **** -- a cathode -- the conductor 30 and the gate electrode 32 are insulated by the insulating layer 33
[0006] the anode according to an ITO film to the pattern configuration which forms an ITO film by the spatter in Ar gas atmosphere, and it shows in drawing 5 by the FOTORISO method to the glass substrate (anode substrate 23) which has insulation and a translucency in producing the anode substrate 23 of FED21 of the above-mentioned composition -- patterning of conductor 26a and the anode wiring 26b is

carried out next, the black matrix layer 27 which consists of graphite material -- a rectangular anode -- a conductor -- it forms in the front face of 26a Then, in opening 27a which the ITO film 26 of the black matrix layer 27 exposes, the fluorescent substance layer 28 of R, G, and B is formed, and the dot-matrix-like light-emitting part 34 is formed.

[0007] Thus, the anode substrate 23 used for conventional FED21 is making the layer structure by which the laminating of nothing and the non-light-emitting part 35 was carried out to the order of a glass substrate (anode substrate 23) / ITO film 26 / black matrix layer 27 in the layer structure by which the laminating of the light-emitting part 34 was carried out to the order of a glass substrate (anode substrate 23) / ITO film 26 / fluorescent substance layer 28, as shown in the cross section of drawing 6 . And the ITO film 26 exists in the whole viewing area, and forms the anode electrode.

[0008]

[Problem(s) to be Solved by the Invention] The non-light-emitting part 35 of the anode substrate 23 of conventional FED21 mentioned above has a layer structure by which the laminating was carried out to the order of a glass substrate (anode substrate 23) / 26/black matrix layer 27 of ITO films, and the ITO film 26 exists under the black matrix layer 27.

[0009] Drawing 7 shows the outdoor daylight reflection factor of the layer structure (BM/Glass) of a glass substrate / black matrix layer, and the layer structure (BM/ITO/Glass) by which the laminating was carried out to the order of a glass substrate / ITO film / black matrix layer.

[0010] As shown in drawing 7 , at the layer structure of a glass substrate / black matrix layer, it turns out to the outdoor daylight reflection factor of a light field being stable that an outdoor daylight reflection factor changes and reflection of near the wavelength of 500nm of a green system is weak with the ITO film by the layer structure by which the laminating was carried out to the order of a glass substrate / ITO film / black matrix layer.

[0011] Therefore, in the layer structure by which the laminating was carried out to the order of the conventional glass substrate / ITO film / black matrix layer, when the glass substrate (anode substrate 23) was observed from the outside, the portion colored it the purplish red color, and could be seen, and there was a problem that display grace fell.

[0012] By the way, in case an ITO film is formed by the spatter on a glass substrate (anode substrate 23), Ar gas is used as spatter gas. For this reason, Ar gas enters into an ITO film at the time of membrane formation, and an ITO film is adsorbed.

[0013] Moreover, in a black matrix layer, although there are not so many burst sizes of Ar gas even if it raises temperature, with an ITO film, it turns out that temperature takes for going up and the burst size of Ar gas is increasing, so that clearly [although drawing 8 shows the amount of Ar gas evolutions of an ITO film and a black matrix layer by temperature up degasifying analysis (TDS) / even if it sees this drawing]. This contains Ar gas on the formed ITO film itself, and means **.

[0014] And the area is the whole viewing area and latus, and, only in the part, the amount of drag-in of the anode electrode which consists of an ITO film 26 formed by the conventional spatter shown in drawing 5 and drawing 6 of Ar gas into 21 FED increases. In addition, since the black matrix layer 27 on the ITO film 26 consists of a porous film, the electron emitted from the field emission form cathode 29 at the time of a drive passes the black matrix layer 27, even the ITO film 26 reaches, and Ar gas by which the ITO film 26 was adsorbed is struck by the electron, and is emitted. Since its rate of the amount of electrons in which the amount of electronic energy passes through the inside of increase and the ITO film 26 increases that the brightness of FED should be raised as this phenomenon carries out the high-pressure drive (for example, about 3-5kV) of the anode, it appears notably. And if Ar gas is emitted as mentioned above, the problem of the degree of vacuum in 21 FED falling, and reducing a life will be caused.

[0015] Furthermore, when the degree of vacuum in a pipe fell by the increase in Ar capacity, there was a problem which causes the phenomenon in which an element breaks and it does not become useful that become easy to discharge by the time of carrying out the high-voltage drive of the anode, this electric discharge serves as a trigger further, and field emission form cathode gets burned etc.

[0016] Moreover, with the composition of the conventional anode substrate 23 mentioned above,

although the permeability of the visible region of an ITO film was about 83%, since the light-emitting part 34 was the layer structure by which the laminating was carried out to the order of a glass substrate (anode substrate 23) / 26/fluorescent substance layer 28 of ITO films, about 10% of luminescence of a fluorescent substance layer was absorbed or reflected by the ITO film 26, and there was a problem that luminescence intensity fell.

[0017] Drawing 9 shows the permeability of a glass substrate and a glass substrate with an ITO film. Even if it sees this drawing, in the case of only a glass substrate, the permeability is about 90% so that clearly. On the other hand, in the case of a glass substrate with an ITO film, permeability with a wavelength of 500nm or less is falling. That is, it turns out that the permeability of a light field will fall if an ITO film exists.

[0018] Then, this invention aims at offering the anode substrate for light emitting devices which is made in view of the above-mentioned trouble, is made to reduce the amount of drag-in of the gas into a pipe, can aim at the life improvement by improvement in a degree of vacuum, loses absorption by the ITO film, and reflection and can aim at improvement in luminescence intensity, and its manufacture method.

[0019]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention of a claim 1 In the anode substrate for light emitting devices from which the interior constitutes a part of aforementioned envelope of the light emitting device which has the envelope held at the vacua the anode which consists of graphite material which has opening in the position which makes a substrate and the light-emitting part in a viewing area, and was formed on the aforementioned substrate -- with the black matrix layer which served as the conductor It is characterized by having the fluorescent substance layer by which covering formation was carried out in the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes.

[0020] In the anode substrate for light emitting devices from which invention of a claim 2 constitutes a part of aforementioned envelope of the light emitting device which has the envelope by which the interior was held at the vacua A substrate and the band-like anode wiring formed on the aforementioned substrate so that it might be pulled out from a viewing area to the edge of the aforementioned substrate, the anode which consists of graphite material which has opening in the position which a part covers the aforementioned anode wiring and makes the light-emitting part in the aforementioned viewing area, and was formed on the aforementioned substrate -- with the black matrix layer which served as the conductor It is characterized by having the fluorescent substance layer by which covering formation was carried out so that the aforementioned black matrix layer might be touched in the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes.

[0021] In the anode substrate for light emitting devices from which invention of a claim 3 constitutes a part of aforementioned envelope of the light emitting device which has the envelope by which the interior was held at the vacua A substrate and the frame formed on the aforementioned substrate so that a viewing area might be surrounded, The anode wiring which consists of the band-like section formed on the aforementioned substrate so that it might be pulled out to the edge of the aforementioned substrate succeeding this frame, the anode which consists of graphite material which has dot-like opening in the position which covers the aforementioned frame of the aforementioned anode wiring, and makes the light-emitting part in the aforementioned viewing area, and was formed on the aforementioned substrate -- with the black matrix layer which served as the conductor It is characterized by having the fluorescent substance layer by which covering formation was carried out at the shape of a dot in the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes.

[0022] In a claim 2 or the anode substrate for light emitting devices of 3, as for invention of a claim 4, the aforementioned anode wiring is characterized by the bird clapper from a transparent electric conduction film or a metal membrane.

[0023] Invention of a claim 5 is characterized by anode driver voltage being 1-7kV in which anode substrate for light emitting devices of claims 1-3.

[0024] In the manufacture method of the anode substrate for light emitting devices that invention of a claim 6 constitutes a part of aforementioned envelope of the light emitting device which has the envelope by which the interior was held at the vacua the anode which has opening in the position which forms the light-emitting part in a viewing area on a substrate -- with the process which forms the black matrix layer which served as the conductor by graphite material It is characterized by including the process which carries out covering formation of the fluorescent substance layer into the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes so that the aforementioned black matrix layer may be touched.
[0025] In the manufacture method of the anode substrate for light emitting devices that invention of a claim 7 constitutes a part of aforementioned envelope of the light emitting device which has the envelope by which the interior was held at the vacua The process which forms anode wiring in band-like by the conductive thin film so that it may be pulled out from a viewing area to the edge of the aforementioned substrate on a substrate, the anode which has opening in the position which a part covers the aforementioned anode wiring and makes the light-emitting part in the aforementioned viewing area -- with the process which forms the black matrix layer which served as the conductor on the aforementioned substrate by graphite material It is characterized by including the process which carries out covering formation of the fluorescent substance layer into the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes.
[0026] In the manufacture method of the anode substrate for light emitting devices that invention of a claim 8 constitutes a part of aforementioned envelope of the light emitting device which has the envelope by which the interior was held at the vacua The frame which encloses a viewing area on a substrate, and the process which forms anode wiring by the conductive thin film so that it may be pulled out to the edge of the aforementioned substrate succeeding this frame, the anode which has dot-like opening in the position which covers the aforementioned frame of the aforementioned anode wiring, and makes the light-emitting part in the aforementioned viewing area -- with the process which forms the black matrix layer which served as the conductor on the aforementioned substrate by graphite material It is characterized by including the process which carries out covering formation of the fluorescent substance layer at the shape of a dot into the aforementioned opening which the front face of the aforementioned substrate of the aforementioned black matrix layer exposes.
[0027] Invention of a claim 9 is characterized by forming the aforementioned anode wiring by the transparent electric conduction film or the metal membrane in the manufacture method of a claim 7 or the anode substrate for light emitting devices of 8.
[0028]
[Embodiments of the Invention] The plan showing the gestalt of operation of the anode substrate according [drawing 1] to this invention, the expansion sectional side elevation (A-A' line cross section of drawing 1) of FED for which drawing 2 used this anode substrate, and drawing 3 (a) - (h) are drawings showing the manufacturing process of this anode substrate.
[0029] In addition, it is omitting about the light-emitting part 7, i.e., the black matrix layer in drawing 2 , and the fluorescent substance layer 8 of the shape of a dot matrix formed in a viewing area in drawing 1 . Moreover, since FED1 of this example shown in drawing 2 has conventional FED21 shown in drawing 6 , and the same composition by the side of the cathode substrate 24, it attaches and explains the same number to the same component.
[0030] FED1 of this example is a display device which performs a full color display, and has the envelope 2 of the shape of a thin shape panel by which the interior was made the high-vacuum state. an envelope 2 sets and meets the anode substrate 3 which has insulation and a translucency, and the cathode substrate 4 which has insulation in a minute interval -- making -- the periphery portion of both the substrates 3 and 4 -- a spacer -- it has structure which prepared and sealed the member 5 (for example, binders, such as a low melting glass) The anode wiring 6 is formed in the inside of the anode substrate 3 of an envelope 2.
[0031] The anode wiring 6 consisted of band-like partial (cash-drawer electrode) 6b pulled out by the edge of the anode substrate 3 from frame part 6a formed in the shape of a frame, and this frame part 6a

so that the viewing area S shown in drawing 1 with an alternate long and short dash line might be surrounded, and the front face of the anode substrate 3 has exposed the inside of frame part 6a.
[0032] As shown in drawing 2 , the black matrix layer 7 which has matrix-like opening 7a is formed in the front face of the anode substrate 3 of the viewing area S located inside frame part 6a of the anode wiring 6. This black matrix layer 7 consists of graphite material which has conductivity.
[0033] Into opening 7a which the anode substrate 3 of the black matrix layer 7 exposes, covering formation of the fluorescent substance layer 8 of R (red), G (green), and B (blue) is carried out so that a part of black matrix layer 7 may be touched at least. The fluorescent substance layer 8 of R, G, and B shown in the example of drawing 2 is put in the shape of a dot so that opening 7a of the black matrix layer 7 may be buried, and it is formed in the front face of the direct anode substrate 3. In FED1 of this example, the portions of nothing and others serve as [the portion on which the fluorescent substance layer 8 was put] the non-light-emitting part 10 in the light-emitting part 9. And an anode electrode is constituted by the above-mentioned anode wiring 6 and the fluorescent substance layer 8. moreover, the black matrix layer 7 in this example -- an anode -- it serves as a conductor and functions as an anode electrode for carrying out excitation luminescence of the fluorescent substance layer 8
[0034] As shown in drawing 2 , the field emission form cathode 29 is formed in the inside of the cathode substrate 4. the cathode with which the field emission form cathode 29 was formed in the inside of the cathode substrate 4 -- a conductor 30 and a cathode -- the emitter 31 of the cone configuration prepared in the conductor 30, and the gate electrode 32 prepared at the nose of cam of an emitter 31 by approaching -- having -- **** -- a cathode -- the conductor 30 and the gate electrode 32 are insulated by the insulating layer 33 and -- this example -- a cathode -- the outgoing radiation of the electron to the fluorescent substance layer 8 used as the candidate for luminescence is controlled by making a conductor 30 and the gate electrode 32 drive alternatively
[0035] In addition, it is good to prepare the electrode for convergence (for it to be effective especially at the time of high-voltage impression) by preparing the 2nd gate electrode through the 2nd insulating layer if needed on the gate electrode 32 etc.
[0036] Next, it explains along with the procedure, referring to drawing 1 - drawing 3 about the production method of the anode substrate 3 of FED1 constituted as mentioned above.
[0037] First, it is the glass substrate (anode substrate 3) which has insulation and a translucency Wet washing and UV/O3 Dry washing is carried out (drawing 3 (a)). Then, the ITO film which is a transparent electric conduction film is formed on a glass substrate 2 by the spatter in Ar gas atmosphere (drawing 3 (b)). The ITO thickness in that case is 0.1-0.15 micrometers, and the sheet resistance at this time is several 10 ohm/cm.
[0038] Next, patterning of the aforementioned ITO film is carried out to the configuration of the anode wiring 6 using the FOTORISO method (drawing 3 (c)). The configuration of the anode wiring 6 by the ITO film at this time consists of band-like section 6b pulled out by the edge of a glass substrate 2 from frame 6a formed so that a viewing area S might be surrounded as shown in drawing 1 , and frame 6a, and the inside of a viewing area S serves as a glass side which removed the ITO film.
[0039] Next, the lift-off film for the reversal development of the black matrix layer 7 is formed with a spinner in sensitization material solution, such as PVA-SbQ and PVA-ADC, (drawing 3 (d)). The thickness of the lift-off film at this time may be 0.3 micrometers - 0.7 micrometers.
[0040] Then, patterning of the aforementioned lift-off film is carried out using the FOTORISO method (drawing 3 (e)). Patterning of the lift-off film is carried out so that frame 6a by the ITO film and the black matrix layer 7 formed at a back process may contact at this time.
[0041] Next, the graphite solution (solution which made the graphite the principal component and contained textile-glass-yarn adhesives and binders, such as water glass and a low melting glass) which is the material of the black matrix layer 7 is formed with a spinner (drawing 3 (f)). The thickness of the graphite film at this time may be 0.6 micrometers - 1.4 micrometers.
[0042] The glass substrate 2 after applying graphite solution as mentioned above is made immersed in an oxidizing solution or alkali system solution, such as a nitric acid, a sulfuric acid, a nitric-acid filtered water, and a sulfuric-acid filtered water, and a lift-off film is made to swell.

[0043] Then, it is 40 degrees C - 45 degrees C hot pure water 5 kgf/cm2 - 8 kgf/cm2 A spray is carried out by the pressure. The lift off of the sensitization material film is carried out by this spray development, and patterning of the black matrix layer 7 is carried out to the pattern configuration of drawing 1 (drawing 3 (g)).
[0044] Next, a fluorescent substance film is formed with PVA-SbQ and PVA-ADC fluorescent substance slurry liquid. The number of layers of the fluorescent substance film at this time may be 1-3 layers. Next, by the FOTORISO method, since equivalent to the opening width of face of opening 7a of the black matrix layer 7, patterning of the fluorescent substance film is carried out to the shape of a dot in the size beyond it, and the fluorescent substance layer 8 is formed (drawing 3 (h)).
[0045] And 545 degrees C and air baking of 200min are performed for the glass substrate with which patterning of an ITO film (anode wiring 6), the black matrix layer 7, and the fluorescent substance layer 8 was carried out. Then, vacuum firing of 560 degrees C and 60min is performed. Thereby, the production process of the anode substrate 3 is completed.
[0046] Thus, the anode substrate 3 of this example is formed as the black matrix layer 7 encloses the direct presentation field S on a glass substrate except for frame 6a of the anode wiring 6, and band-like section 6b, and covering formation of the direct fluorescent substance layer 8 is carried out on the glass substrate in opening 7a of the black matrix layer 7.
[0047] Therefore, in the portion of the black matrix layer 7 without an ITO film, as shown in drawing 7 , the outdoor daylight reflection factor of a light field is stabilized, it becomes black, outdoor daylight reflectivity changes with an ITO film like before, it is not visible to a purplish red color, and improvement in display grace can be aimed at. And since the fluorescent substance layer 8 is formed on the direct glass substrate 2, reflection and absorption of an ITO film can be disregarded and luminescence intensity can be raised rather than the structure by which the laminating was carried out to the order of the conventional glass substrate / ITO film / fluorescent substance layer (refer to drawing 7).
[0048] moreover -- according to the anode substrate 3 of this example -- conductivity, since the black matrix layer 7 which consists of graphite material which is a member serves also as the function as an anode electrode (anode conductor) The area of the anode wiring 6 formed by the ITO film as compared with the conventional anode substrate 23 shown in drawing 5 and drawing 6 is reduced sharply, and while the amount of drag-in of Ar gas at the time of forming an ITO film becomes less, the fall of the degree of vacuum in the FED pipe by Ar gas evolution can be suppressed. Consequently, compared with the former, a life property becomes good, electric discharge is also generated and the effect of ****** is done so.
[0049] Since the anode wiring 6 in the gestalt of the above-mentioned implementation is formed in the outside of a viewing area S, it can use metal membranes, such as not only an ITO film but aluminum, Nb, Mo, Au, Ti, etc. Consequently, material with stable low thing of resistivity and resistivity can be used. In addition, in that case, only when a reversal developer is an alkali system, it is restricted.
[0050] Furthermore, as shown in drawing 1 , when carrying out by carrying out a contact flow by the JIMETTO line which has the black matrix layer 7 which functions also considering the cash drawer of the anode wiring 6 as not the anode substrate 3 top but an anode electrode let it pass within [non-illustrated] exhaust air, the anode wiring 6 which consists of an ITO film (or metal membrane) formed in the outside of a viewing area S as shown in drawing 1 becomes unnecessary. That is, all the anode electrodes can be formed in the black matrix layer 7. The ITO film made into the problem in the conventional structure can be removed by this, and the anode substrate 3 can be produced.
[0051] In addition, if it makes the portion (band-like section 6b of the anode wiring 6) equivalent to a cash-drawer electrode the composition which carried out the laminating to the order of a glass substrate (anode substrate 3) / 7/encapsulant (spacer member 5) of black matrix layers in performing the cash drawer of a direct anode electrode from the anode substrate 3 side, possibility that leak will occur at the time of sealing of the anode substrate 3 and the cathode substrate 4 will arise. Therefore, band-like section 6b of the anode wiring 6 equivalent to a cash-drawer electrode is needed.
[0052] Drawing 4 shows the relation between driver voltage and electric discharge by this invention in

structure and the conventional structure. As a measurement sample, 1 type FED (it is the device of 1 inch of vertical angles, and the gap between anode-cathodes of this device is 1.0mm) was used.
[0053] With the conventional composition, the electric discharge measurement size is also increasing as an electric discharge sample arises and the driver voltage of an anode becomes high, when driver voltage of an anode is set to 5kV so that clearly also from this drawing 4 .
[0054] On the other hand, with the composition of this example, even if an electric discharge sample does not have the driver voltage of an anode and 7kV makes driver voltage of an anode high, it is known by that there are few electric discharge measurement sizes compared with the conventional composition. Therefore, according to the composition of this example, the driver voltage of an anode can set by 7kV, and can offer FED which can be displayed, without generating an electric discharge sample.
[0055] By the way, it is desirable to form frame 6a in the shape of [of a rice field] a character, and to divide a viewing area S into plurality with the composition shown in drawing 1 and drawing 2 , when a viewing area S becomes large, although the anode wiring 6 is a configuration with frame 6a and band-like section 6b and is satisfactory about the small thing of a viewing area S (panel size). This is because a voltage drop becomes large by the large-sized panel since resistance of BM is not so low as ITO (sheet resistance of 1000 or more ohm/cm).
[0056] Moreover, although the anode substrate 3 of the gestalt of operation mentioned above was explained taking the case of the case where it uses for FED1 as a light emitting device, if the interior is the light emitting device which has the envelope held at the vacua, it can also be used for a fluorescent display (VFD), a high-pressure luminescence cell, large-sized display (huge TRON), etc., for example.
[0057]
[Effect of the Invention] By the above explanation, the outdoor daylight reflection factor of a light field is stabilized, it becomes black in the portion of the black matrix layer which does not have a transparent electric conduction film (ITO film) according to this invention so that clearly, outdoor daylight reflectivity changes with an ITO film like before, it is not visible to a purplish red color, and improvement in display grace can be aimed at. And since a fluorescent substance layer is formed on a direct substrate, reflection and absorption of an ITO film can be disregarded and luminescence intensity can be raised rather than the structure by which the laminating was carried out to the order of the conventional glass substrate / ITO film / fluorescent substance layer.
[0058] moreover, conductivity -- since the black matrix layer which consists of graphite material which is a member serves as an electrode, the area of the anode electrode formed by the ITO film as compared with the conventional anode substrate is reduced sharply, and while the amount of drag-in of Ar gas at the time of forming an ITO film becomes less, the fall of the degree of vacuum in the FED pipe by Ar gas evolution can be suppressed Consequently, compared with the former, a life property becomes good, electric discharge is also generated and the effect of ****** is done so.
[0059] Since anode wiring is formed in the outside of a viewing area, it can use metal membranes, such as not only an ITO film but aluminum, Nb, Mo, Au, Ti, etc.

[Translation done.]

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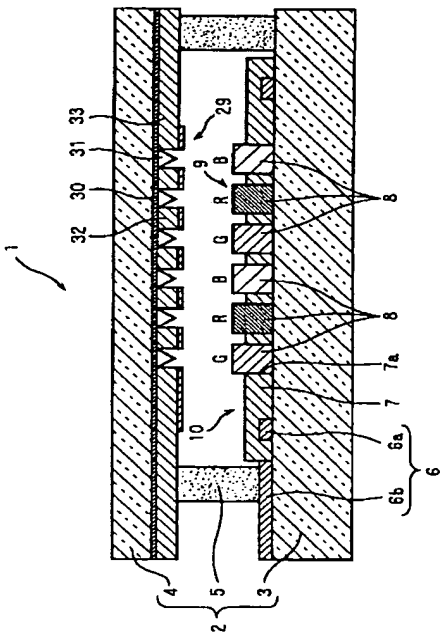
最終頁に続く

(54)【発明の名称】　発光素子用アノード基板およびその製造方法

(57)【要約】
【課題】　管内へのガスの持ち込み量を低減させ、真空度の向上による寿命改善を図り、ＩＴＯ膜による吸収、反射を無くして発光強度の向上を図る。
【解決手段】　ＦＥＤ１は、電界放出形陰極２９が形成されたカソード基板４と、アノード基板３の外周部分がスペーサ部材５を介して封着され、内部が真空状態に保持された外囲器２を構成する。アノード基板３上には、表示領域を取り囲む枠状部６ａと、枠状部６ａに連続して基板３の端部まで引き出される帯状部６ｂからなるアノード電極６が形成される。基板３上には、アノード電極６の枠状部６ａを覆い、かつ表示領域内の発光部をなす位置に開口部７ａを有するブラックマトリクス層７が黒鉛材料により形成される。ブラックマトリクス層７の基板３の表面が露出する開口部７ａ内には、ドット状の蛍光体層８が被着形成される。



【特許請求の範囲】

【請求項１】　内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板において、

基板と、

表示領域内の発光部をなす位置に開口部を有して前記基板上に形成された黒鉛材料からなるアノード導体を兼ねたブラックマトリクス層と、

前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に被着形成された蛍光体層とを備えたことを特徴とする発光素子用アノード基板。

【請求項２】　内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板において、

基板と、

表示領域から前記基板の端部まで引き出されるように前記基板上に形成された帯状のアノード配線と、

一部が前記アノード配線を覆い、かつ前記表示領域内の発光部をなす位置に開口部を有して前記基板上に形成された黒鉛材料からなるアノード導体を兼ねたブラックマトリクス層と、

前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に前記ブラックマトリクス層に接するように被着形成された蛍光体層とを備えたことを特徴とする発光素子用アノード基板。

【請求項３】　内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板において、

基板と、

表示領域を取り囲むように前記基板上に形成された枠状部と、該枠状部に連続して前記基板の端部まで引き出されるように前記基板上に形成された帯状部とからなるアノード配線と、

前記アノード配線の前記枠状部を覆い、かつ前記表示領域内の発光部をなす位置にドット状の開口部を有して前記基板上に形成された黒鉛材料からなるアノード導体を兼ねたブラックマトリクス層と、

前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内にドット状に被着形成された蛍光体層とを備えたことを特徴とする発光素子用アノード基板。

【請求項４】　前記アノード配線が透明導電膜又は金属膜からなることを特徴とする請求項２又は３記載の発光素子用アノード基板。

【請求項５】　アノード駆動電圧が１～７ｋＶであることを特徴とする請求項１～３の何れかに記載の発光素子用アノード基板。

【請求項６】　内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板の製造方法において、

基板上に、表示領域内の発光部を形成する位置に開口部を有するアノード導体を兼ねたブラックマトリクス層を黒鉛材料によって形成する工程と、

前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に蛍光体層を前記ブラックマトリクス層に接するように被着形成する工程とを含むことを特徴とする発光素子用アノード基板の製造方法。

【請求項７】　内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板の製造方法において、

基板上に、表示領域から前記基板の端部まで引き出されるように帯状にアノード配線を導電性薄膜により形成する工程と、

一部が前記アノード配線を覆い、かつ前記表示領域内の発光部をなす位置に開口部を有するアノード導体を兼ねたブラックマトリクス層を黒鉛材料によって前記基板上に形成する工程と、

前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に蛍光体層を被着形成する工程とを含むことを特徴とする発光素子用アノード基板の製造方法。

【請求項８】　内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板の製造方法において、

基板上に、表示領域を取り囲む枠状部と、該枠状部に連続して前記基板の端部まで引き出されるようにアノード配線を導電性薄膜により形成する工程と、

前記アノード配線の前記枠状部を覆い、かつ前記表示領域内の発光部をなす位置にドット状の開口部を有するアノード導体を兼ねたブラックマトリクス層を黒鉛材料によって前記基板上に形成する工程と、

前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に蛍光体層をドット状に被着形成する工程とを含むことを特徴とする発光素子用アノード基板の製造方法。

【請求項９】　前記アノード配線を透明導電膜又は金属膜で形成することを特徴とする請求項７又は８記載の発光素子用アノード基板の製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電界放出形表示装置（ＦＥＤ：Field Emission Display）、蛍光表示管（ＶＦＤ）、高圧発光セル、大型表示装置（ジャンボトロン）等の発光素子に用いられる発光素子用アノード基板およびその製造方法に関する。

【０００２】

【従来の技術】図５は従来のアノード基板の平面図、図６は図５のアノード基板を用いたＦＥＤの拡大側断面図である。なお、図５において表示領域に形成されるドットマトリクス状の発光部、すなわち図６におけるブラックマトリクス層２７及び蛍光体層２８については省略している。

【０００３】図６に示すＦＥＤ２１は、内部が高真空状態とされた薄型パネル状の外囲器２２を有している。外囲器２２は、アノード基板２３とカソード基板２４を微小な間隔をおいて対面させ、両基板２３，２４の外周部分にスペーサ部材２５（例えば低融点ガラス等の接着剤からなる封着剤）を設けて封着した構造となっている。外囲器２２のアノード基板２３の内面には、酸化インジウムと錫の複合酸化物であるＩＴＯ(Indium Tin Oxide)からなる透明導電膜（以下、ＩＴＯ膜という）２６が形成されている。

【０００４】図５に示すように、ＩＴＯ膜２６は、一点鎖線で示す表示領域Ｓよりも若干広めにベタ状に形成された矩形のアノード導体２６ａと、このアノード導体２６ａからアノード基板２３の端部に引き出された帯状の引出し電極であるアノード配線２６ｂからなる。ＩＴＯ膜２６のアノード導体２６ａの表面の表示領域内には、図６に示すように、マトリクス状の開口部２７ａを有する黒鉛材料からなるブラックマトリクス層２７が形成されている。図６に示すように、ブラックマトリクス層２７のＩＴＯ膜２６が露出する開口部２７ａ内には、Ｒ（赤色），Ｇ（緑色），Ｂ（青色）のドット状の蛍光体層２８が被着されている。そして、上記アノード導体２６ａとアノード配線２６ｂと蛍光体層２８によりアノード電極が構成される。

【０００５】図６に示すように、カソード基板２４の内面には、電界放出形陰極２９が設けられている。電界放出形陰極２９は、カソード基板２４の内面に設けられたカソード導体３０と、カソード導体３０に設けられたコーン形状のエミッタ３１と、エミッタ３１の先端に近接して設けられたゲート電極３２とを有しており、カソード導体３０とゲート電極３２は絶縁層３３で絶縁されている。

【０００６】上記構成のＦＥＤ２１のアノード基板２３を作製する場合には、絶縁性及び透光性を有するガラス基板（アノード基板２３）に対し、Ａｒガス雰囲気中でスパッタ法によりＩＴＯ膜を成膜し、フォトリソ法で図５に示すパターン形状にＩＴＯ膜によるアノード導体２６ａ及びアノード配線２６ｂをパターニングする。次に、黒鉛材料からなるブラックマトリクス層２７を矩形のアノード導体２６ａの表面に形成する。その後、ブラックマトリクス層２７のＩＴＯ膜２６が露出する開口部２７ａ内にR，G，Bの蛍光体層２８を形成してドットマトリクス状の発光部３４を形成する。

【０００７】このように、従来のＦＥＤ２１に用いられるアノード基板２３は、図６の断面図で示すように、発光部３４がガラス基板（アノード基板２３）／ＩＴＯ膜２６／蛍光体層２８の順に積層された層構造をなし、非発光部３５がガラス基板（アノード基板２３）／ＩＴＯ膜２６／ブラックマトリクス層２７の順に積層された層構造をなしている。そして、ＩＴＯ膜２６が表示領域全体に存在してアノード電極を形成している。

【０００８】

【発明が解決しようとする課題】上述した従来のＦＥＤ２１のアノード基板２３の非発光部３５は、ガラス基板（アノード基板２３）／ＩＴＯ膜２６／ブラックマトリクス層２７の順に積層された層構造になっており、ブラックマトリクス層２７の下にＩＴＯ膜２６が存在する。

【０００９】図７はガラス基板／ブラックマトリクス層の層構造（ＢＭ／Ｇｌａｓｓ）と、ガラス基板／ＩＴＯ膜／ブラックマトリクス層の順に積層された層構造（ＢＭ／ＩＴＯ／Ｇｌａｓｓ）の外光反射率を示している。

【００１０】図７に示すように、ガラス基板／ブラックマトリクス層の層構造では可視光領域の外光反射率が安定しているのに対し、ガラス基板／ＩＴＯ膜／ブラックマトリクス層の順に積層された層構造では、ＩＴＯ膜によって外光反射率が変わり、緑色系の波長５００ｎｍ付近の反射が弱くなっているのが判る。

【００１１】したがって、従来のガラス基板／ＩＴＯ膜／ブラックマトリクス層の順に積層された層構造では、ガラス基板（アノード基板２３）を外側から観察すると、その部分が赤紫色に着色して見え、表示品位が低下するという問題があった。

【００１２】ところで、ＩＴＯ膜をガラス基板（アノード基板２３）上にスパッタ法により成膜する際、スパッタガスとしてはＡｒガスが使用される。このため、成膜時にＡｒガスがＩＴＯ膜中に入り込んでＩＴＯ膜に吸着される。

【００１３】また、図８は昇温脱ガス分析（ＴＤＳ）によるＩＴＯ膜とブラックマトリクス層のＡｒガス放出量を示しているが、この図を見ても明らかなように、ブラックマトリクス層では、温度を上昇させてもそれほどＡｒガスの放出量は多くないが、ＩＴＯ膜では、温度が上昇するに連れてＡｒガスの放出量が増していることが判る。このことは、成膜されたＩＴＯ膜自身にＡｒガスを含有しているを意味している。

【００１４】そして、図５及び図６に示す従来のスパッタ法で形成したＩＴＯ膜２６からなるアノード電極は、その面積が表示領域全体と広いので、その分だけＦＥＤ２１管内へのＡｒガスの持ち込み量が増える。加えて、ＩＴＯ膜２６上のブラックマトリクス層２７がポーラスな膜からなるため、駆動時に電界放出形陰極２９から放出された電子がブラックマトリクス層２７を通過してＩＴＯ膜２６まで到達し、ＩＴＯ膜２６に吸着されたＡｒガスが電子により叩かれて放出される。この現象は、ＦＥＤの輝度を向上させるべく、アノードを高圧駆動（例えば３～５ｋＶ程度）するに従って電子のエネルギー量が増し、ＩＴＯ膜２６中を通過する電子量の割合が増すために顕著に現れる。そして、上述したように、Ａｒガスが放出されると、ＦＥＤ２１管内の真空度が低下し、寿命を低下させるという問題を招く。

【００１５】さらに、Ａｒガス量の増加により管内の真空度が低下すると、アノードを高電圧駆動した際により放電しやすくなり、さらにこの放電が引き金となって電界放出形陰極が焦げつくなど、素子が破壊して使い物にならないといった現象を引き起こす問題があった。

【００１６】また、ＩＴＯ膜の可視領域の透過率は約８３％であるが、上述した従来のアノード基板２３の構成では、発光部３４がガラス基板（アノード基板２３）／ＩＴＯ膜２６／蛍光体層２８の順に積層された層構造なので、蛍光体層の発光の約１０％がＩＴＯ膜２６で吸収または反射され、発光強度が低下するという問題があった。

【００１７】図９はガラス基板とＩＴＯ膜付きガラス基板の透過率を示している。この図を見ても明らかなように、ガラス基板のみの場合では、その透過率が約９０％である。これに対し、ＩＴＯ膜付きガラス基板の場合、波長５００ｎｍ以下の透過率が低下している。つまり、可視光領域の透過率は、ＩＴＯ膜が存在すると低下しているのが判る。

【００１８】そこで、本発明は、上記問題点に鑑みてなされたものであり、管内へのガスの持ち込み量を低減させ、真空度の向上による寿命改善が図れ、ＩＴＯ膜による吸収、反射を無くして発光強度の向上が図れる発光素子用アノード基板およびその製造方法を提供することを目的としている。

【００１９】

【課題を解決するための手段】上記目的を達成するため、請求項１の発明は、内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板において、基板と、表示領域内の発光部をなす位置に開口部を有して前記基板上に形成された黒鉛材料からなるアノード導体を兼ねたブラックマトリクス層と、前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に被着形成された蛍光体層とを備えたことを特徴とする。

【００２０】請求項２の発明は、内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板において、基板と、表示領域から前記基板の端部まで引き出されるように前記基板上に形成された帯状のアノード配線と、一部が前記アノード配線を覆い、かつ前記表示領域内の発光部をなす位置に開口部を有して前記基板上に形成された黒鉛材料からなるアノード導体を兼ねたブラックマトリクス層と、前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に前記ブラックマトリクス層に接するように被着形成された蛍光体層とを備えたことを特徴とする。

【００２１】請求項３の発明は、内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板において、基板と、表示領域を取り囲むように前記基板上に形成された枠状部と、該枠状部に連続して前記基板の端部まで引き出されるように前記基板上に形成された帯状部とからなるアノード配線と、前記アノード配線の前記枠状部を覆い、かつ前記表示領域内の発光部をなす位置にドット状の開口部を有して前記基板上に形成された黒鉛材料からなるアノード導体を兼ねたブラックマトリクス層と、前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内にドット状に被着形成された蛍光体層とを備えたことを特徴とする。

【００２２】請求項４の発明は、請求項２又は３の発光素子用アノード基板において、前記アノード配線が透明導電膜又は金属膜からなることを特徴とする。

【００２３】請求項５の発明は、請求項１～３の何れかの発光素子用アノード基板において、アノード駆動電圧が１～７ｋＶであることを特徴とする。

【００２４】請求項６の発明は、内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板の製造方法において、基板上に、表示領域内の発光部を形成する位置に開口部を有するアノード導体を兼ねたブラックマトリクス層を黒鉛材料によって形成する工程と、前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に蛍光体層を前記ブラックマトリクス層に接するように被着形成する工程とを含むことを特徴とする。

【００２５】請求項７の発明は、内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板の製造方法において、基板上に、表示領域から前記基板の端部まで引き出されるように帯状にアノード配線を導電性薄膜により形成する工程と、一部が前記アノード配線を覆い、かつ前記表示領域内の発光部をなす位置に開口部を有するアノード導体を兼ねたブラックマトリクス層を黒鉛材料によって前記基板上に形成する工程と、前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に蛍光体層を被着形成する工程とを含むことを特徴とする。

【００２６】請求項８の発明は、内部が真空状態に保持された外囲器を有する発光素子の前記外囲器の一部を構成する発光素子用アノード基板の製造方法において、基板上に、表示領域を取り囲む枠状部と、該枠状部に連続して前記基板の端部まで引き出されるようにアノード配線を導電性薄膜により形成する工程と、前記アノード配線の前記枠状部を覆い、かつ前記表示領域内の発光部をなす位置にドット状の開口部を有するアノード導体を兼ねたブラックマトリクス層を黒鉛材料によって前記基板上に形成する工程と、前記ブラックマトリクス層の前記基板の表面が露出する前記開口部内に蛍光体層をドット状に被着形成する工程とを含むことを特徴とする。

【００２７】請求項９の発明は、請求項７又は８の発光素子用アノード基板の製造方法において、前記アノード

配線を透明導電膜又は金属膜で形成することを特徴とする。

【００２８】

【発明の実施の形態】図１は本発明によるアノード基板の実施の形態を示す平面図、図２は同アノード基板を用いたＦＥＤの拡大側断面図（図１のＡ－Ａ’線断面図）、図３（ａ）～（ｈ）は同アノード基板の製造工程を示す図である。

【００２９】なお、図１において表示領域に形成されるドットマトリクス状の発光部、すなわち図２におけるブラックマトリクス層７及び蛍光体層８については省略している。また、図２に示す本例のＦＥＤ１は、図６に示す従来のＦＥＤ２１とカソード基板２４側の構成が同一なので、同一の構成要素には同一番号を付して説明する。

【００３０】本例のＦＥＤ１は、フルカラー表示を行う表示素子であり、内部が高真空状態とされた薄型パネル状の外囲器２を有している。外囲器２は、絶縁性及び透光性を有するアノード基板３と、絶縁性を有するカソード基板４とを微小な間隔をおいて対面させ、両基板３，４の外周部分にスペーサ部材５（例えば低融点ガラス等の接着材）を設けて封着した構造となっている。外囲器２のアノード基板３の内面には、アノード配線６が形成されている。

【００３１】アノード配線６は、図１に一点鎖線で示す表示領域Ｓを取り囲むように枠状に形成された枠状部分６ａと、この枠状部分６ａからアノード基板３の端部に引き出された帯状部分（引出し電極）６ｂからなり、枠状部分６ａ内はアノード基板３の表面が露出している。

【００３２】アノード配線６の枠状部分６ａの内側に位置する表示領域Ｓのアノード基板３の表面には、図２に示すように、マトリクス状の開口部７ａを有するブラックマトリクス層７が形成されている。このブラックマトリクス層７は、導電性を有する黒鉛材料からなる。

【００３３】ブラックマトリクス層７のアノード基板３が露出する開口部７ａ内には、少なくともブラックマトリクス層７の一部に接するようにＲ（赤色），Ｇ（緑色），Ｂ（青色）の蛍光体層８が被着形成されている。図２の例に示すＲ，Ｇ，Ｂの蛍光体層８は、ブラックマトリクス層７の開口部７ａを埋めるようにドット状に被着され、直接アノード基板３の表面に形成されている。本例のＦＥＤ１では、蛍光体層８が被着された部分が発光部９をなし、その他の部分が非発光部１０となっている。そして、上記アノード配線６と蛍光体層８によりアノード電極が構成される。また、本例におけるブラックマトリクス層７は、アノード導体を兼ね、蛍光体層８を励起発光させるためのアノード電極として機能する。

【００３４】図２に示すように、カソード基板４の内面には、電界放出形陰極２９が設けられている。電界放出形陰極２９は、カソード基板４の内面に設けられたカソード導体３０と、カソード導体３０に設けられたコーン形状のエミッタ３１と、エミッタ３１の先端に近接して設けられたゲート電極３２とを有しており、カソード導体３０とゲート電極３２は絶縁層３３で絶縁されている。そして、本例では、カソード導体３０とゲート電極３２を選択的に駆動させることにより、発光対象となる蛍光体層８への電子の出射が制御される。

【００３５】尚、必要に応じてゲート電極３２上に第２の絶縁層を介して第２のゲート電極を設ける等により、集束用電極（特に、高電圧印加時に有効である）を設けると良い。

【００３６】次に、上記のように構成されるＦＥＤ１のアノード基板３の作製方法について図１～図３を参照しながらその手順に沿って説明する。

【００３７】まず、絶縁性及び透光性を有するガラス基板（アノード基板３）をウェット洗浄とＵＶ／O_3ドライ洗浄する（図３（ａ））。その後、Ａｒガス雰囲気中でスパッタ法により透明導電膜であるＩＴＯ膜をガラス基板２上に成膜する（図３（ｂ））。その際のＩＴＯ膜厚は、例えば０．１～０．１５μｍであり、この時のシート抵抗は数１０Ω／ｃｍである。

【００３８】次に、フォトリソ法を用いて前記ＩＴＯ膜をアノード配線６の形状にパターニングする（図３（ｃ））。この時のＩＴＯ膜によるアノード配線６の形状は、図１に示すように、表示領域Ｓを取り囲むように形成された枠状部６ａと、枠状部６ａからガラス基板２の端部に引き出された帯状部６ｂからなり、表示領域Ｓ内はＩＴＯ膜を除去したガラス面となっている。

【００３９】次に、ブラックマトリクス層７の反転現像用のリフトオフ膜をＰＶＡ－ＳｂＱ，ＰＶＡ－ＡＤＣ等の感光材水溶液でスピンナーにより形成する（図３（ｄ））。この時のリフトオフ膜の膜厚は０．３μｍ～０．７μｍとする。

【００４０】続いて、前記リフトオフ膜をフォトリソ法を用いてパターニングする（図３（ｅ））。この時にＩＴＯ膜による枠状部６ａと後工程で形成されるブラックマトリクス層７とがコンタクトするようにリフトオフ膜をパターニングする。

【００４１】次に、ブラックマトリクス層７の材料である黒鉛水溶液（黒鉛を主成分とし、水ガラスや低融点ガラス等のガラス系接着剤及びバインダーを含有した水溶液）をスピンナーで形成する（図３（ｆ））。この時の黒鉛膜の膜厚は０．６μｍ～１．４μｍとする。

【００４２】上記のように黒鉛水溶液を塗布した後のガラス基板２を硝酸、硫酸、硝酸過水、硫酸過水等の酸化性溶液またはアルカリ系水溶液に浸らせてリフトオフ膜を膨潤させる。

【００４３】その後、４０℃～４５℃の温純水を５ｋｇｆ／ｃｍ^2～８ｋｇｆ／ｃｍ^{2}の圧力でスプレーする。このスプレー現像により感光材膜をリフトオフしてブラ

ックマトリクス層７が図１のパターン形状にパターニングされる（図３（ｇ））。

【００４４】次に、ＰＶＡ－ＳｂＱ，ＰＶＡ－ＡＤＣ蛍光体スラリー液で蛍光体膜を形成する。この時の蛍光体膜の層数は１～３層とする。次に、フォトリソ法でブラックマトリクス層７の開口部７ａの開口幅と同等からそれ以上の大きさで蛍光体膜をドット状にパターニングして蛍光体層８を形成する（図３（ｈ））。

【００４５】そして、ＩＴＯ膜（アノード配線６）、ブラックマトリクス層７、蛍光体層８がパターニングされたガラス基板を５４５℃、２００ｍｉｎの大気焼成を行う。その後、５６０℃、６０ｍｉｎの真空焼成を行う。これにより、アノード基板３の作製工程が完了する。

【００４６】このように、本例のアノード基板３は、ブラックマトリクス層７がアノード配線６の枠状部６ａと帯状部６ｂを除いてガラス基板上に直接表示領域Ｓを取り囲むようにして形成され、ブラックマトリクス層７の開口部７ａ内のガラス基板上に直接蛍光体層８が被着形成される。

【００４７】したがって、ＩＴＯ膜の無いブラックマトリクス層７の部分では、図７に示すように、可視光領域の外光反射率が安定して黒色になり、従来のようなＩＴＯ膜により外光反射強度が変わって赤紫色に見えることがなく、表示品位の向上を図ることができる。しかも、蛍光体層８が直接ガラス基板２上に形成されるので、ＩＴＯ膜の反射及び吸収を無視でき、従来のガラス基板／ＩＴＯ膜／蛍光体層の順に積層された構造よりも発光強度を向上させることができる（図７参照）。

【００４８】また、本例のアノード基板３によれば、導電性部材である黒鉛材料からなるブラックマトリクス層７がアノード電極（アノード導体）としての機能も兼ねるので、図５及び図６に示す従来のアノード基板２３と比較して、ＩＴＯ膜で形成されるアノード配線６の面積が大幅に縮小され、ＩＴＯ膜を成膜した際のＡｒガスの持ち込み量が減るとともに、Ａｒガス放出によるＦＥＤ管内の真空度の低下を抑えることができる。その結果、従来に比べて寿命特性が良くなり、放電も発生しずらいという効果を奏する。

【００４９】上記実施の形態におけるアノード配線６は、表示領域Ｓの外側に形成されるので、ＩＴＯ膜に限らず、Ａｌ，Ｎｂ，Ｍｏ，Ａｕ，Ｔｉ等の金属膜を使用することができる。その結果、抵抗率の低いものや抵抗率の安定な材料を使用できる。なお、その際、反転現像液がアルカリ系の場合のみに限られる。

【００５０】さらに、図１に示すように、アノード配線６の引出しをアノード基板３上でなく、アノード電極としても機能するブラックマトリクス層７に不図示の排気管内を通されるジメット線等により接触導通させて行う場合は、図１に示すような表示領域Ｓの外側に形成されるＩＴＯ膜（又は金属膜）からなるアノード配線６が不要となる。すなわち、アノード電極の全てをブラックマトリクス層７で形成することができる。これにより、従来の構造において問題とされていたＩＴＯ膜を除去してアノード基板３を作製することができる。

【００５１】なお、アノード基板３側から直接アノード電極の引出しを行う場合には、引出し電極に当たる部分（アノード配線６の帯状部６ｂ）をガラス基板（アノード基板３）／ブラックマトリクス層７／封止剤（スペーサ部材５）の順に積層した構成にすると、アノード基板３とカソード基板４の封着時にリークが発生する可能性が生ずる。従って、引出し電極に当たるアノード配線６の帯状部６ｂは必要となる。

【００５２】図４は本発明による構造と従来の構造における駆動電圧と放電の関係を示している。測定サンプルとしては１型のＦＥＤ（対角１インチのデバイスであり、このデバイスのアノード－カソード間ギャップは１．０ｍｍ）を用いた。

【００５３】この図４からも明らかなように、従来の構成では、アノードの駆動電圧を５ｋＶとしたときに放電サンプルが生じ、アノードの駆動電圧が高くなるに従って放電サンプル数も増している。

【００５４】これに対し、本例の構成では、アノードの駆動電圧が７ｋＶまでは放電サンプルがなく、アノードの駆動電圧を高くしても従来の構成に比べて放電サンプル数が少ないことが判る。したがって、本例の構成によれば、アノードの駆動電圧が７ｋＶまでにおいては、放電サンプルを発生させずに表示可能なＦＥＤを提供することができる。

【００５５】ところで、図１及び図２に示す構成では、アノード配線６が枠状部６ａと帯状部６ｂを有した形状であり、表示領域Ｓ（パネルサイズ）の小さいものについては問題ないが、表示領域Ｓが広くなった場合には枠状部６ａを例えば田の字状に形成して表示領域Ｓを複数に分割するのが好ましい。これは、ＢＭの抵抗はＩＴＯ程低くない（１０００Ω／ｃｍ以上のシート抵抗）ため大型パネルでは電圧降下が大きくなるからである。

【００５６】また、上述した実施の形態のアノード基板３は、発光素子としてＦＥＤ１に用いた場合を例にとって説明したが、内部が真空状態に保持された外囲器を有する発光素子であれば、例えば蛍光表示管（ＶＦＤ）、高圧発光セル、大型表示装置（ジャンボトロン）等に用いることもできる。

【００５７】

【発明の効果】以上の説明で明らかなように、本発明によれば、透明導電膜（ＩＴＯ膜）の無いブラックマトリクス層の部分では、可視光領域の外光反射率が安定して黒色になり、従来のようなＩＴＯ膜により外光反射強度が変わって赤紫色に見えることがなく、表示品位の向上を図ることができる。しかも、蛍光体層が直接基板上に形成されるので、ＩＴＯ膜の反射及び吸収を無視でき、

従来のガラス基板／ＩＴＯ膜／蛍光体層の順に積層された構造よりも発光強度を向上させることができる。

【００５８】また、導電性部材である黒鉛材料からなるブラックマトリクス層が電極を兼ねるので、従来のアノード基板と比較して、ＩＴＯ膜で形成されるアノード電極の面積が大幅に縮小され、ＩＴＯ膜を成膜した際のＡｒガスの持ち込み量が減るとともに、Ａｒガス放出によるＦＥＤ管内の真空度の低下を抑えることができる。その結果、従来に比べて寿命特性が良くなり、放電も発生しずらいという効果を奏する。

【００５９】アノード配線は、表示領域の外側に形成されるので、ＩＴＯ膜に限らず、Ａｌ，Ｎｂ，Ｍｏ，Ａｕ，Ｔｉ等の金属膜を使用することができる。

【図面の簡単な説明】

【図１】本発明によるアノード基板の実施の形態を示す平面図

【図２】本発明によるアノード基板を用いた電界放出形表示装置の拡大側断面図

【図３】（ａ）～（ｈ）本発明によるアノード基板の製造工程を示す図

【図４】本発明による構造と従来の構造における駆動電圧と放電の関係を示す図

【図５】従来のアノード基板の平面図

【図６】図５のアノード基板を用いた電界放出形表示装置の拡大側断面図

【図７】ブラックマトリクス／ガラス基板の層構造とブラックマトリクス／ＩＴＯ膜／ガラス基板の層構造の外光反射率を示す図

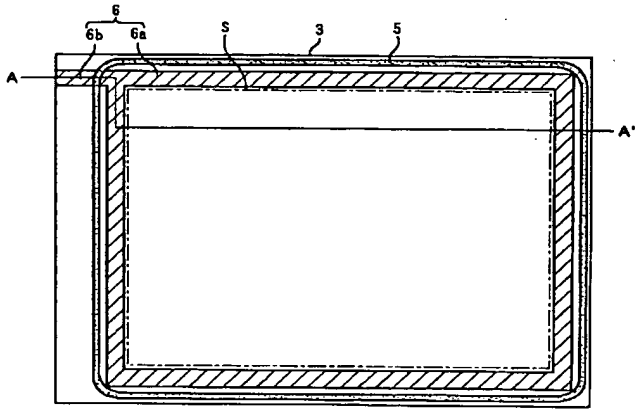
【図８】ＩＴＯとブラックマトリクスのＡｒガス放出量を示す図

【図９】ガラス基板とＩＴＯ膜付きガラス基板の透過率を示す図

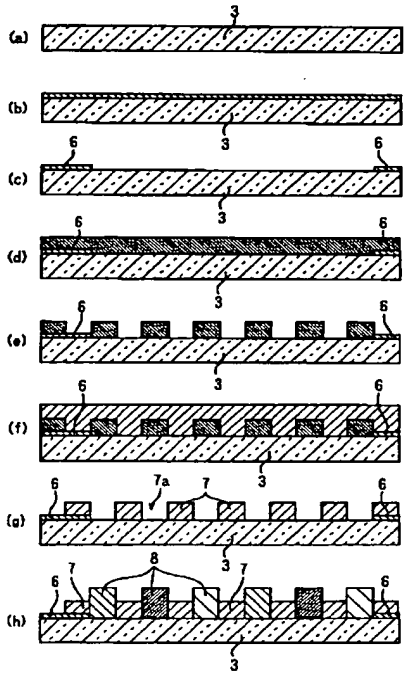
【符号の説明】

１…ＦＥＤ（発光素子）、２…外囲器、３…アノード基板、６…アノード配線、６ａ…枠状部、６ｂ…帯状部、７…ブラックマトリクス層、７ａ…開口部、８…蛍光体層、９…発光部、１０…非発光部、Ｓ…表示領域。

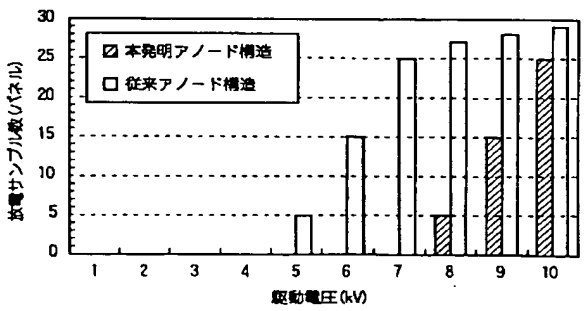
【図１】



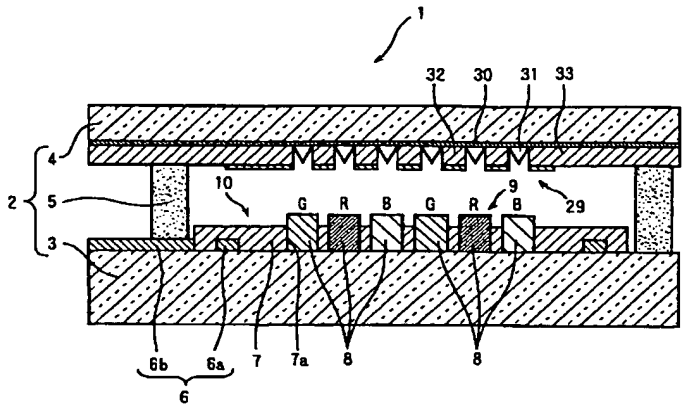
【図３】



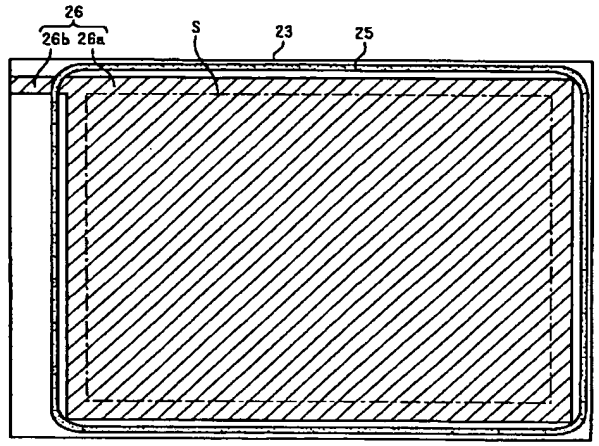
【図４】



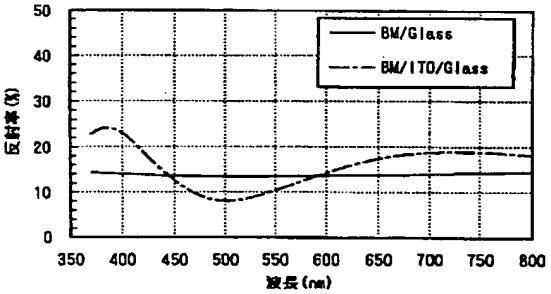
【図２】


1
32
30
31
33
4
2
5
3
10
9
G
R
B
G
R
B
29
6b
6a
7
7a
8
8
6

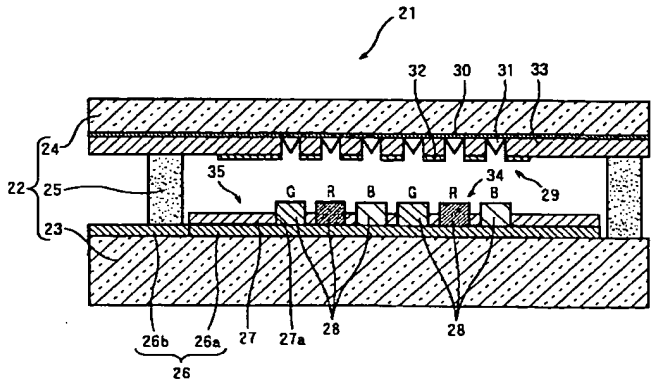
【図５】


26
26b
26a
S
23
25

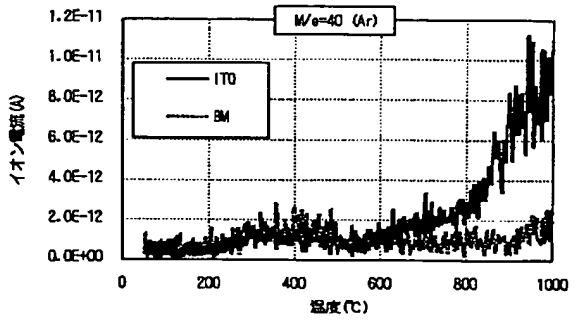
【図７】


BM/Glass
BM/ITO/Glass
反射率(%)
50
40
30
20
10
0
350
400
450
500
550
600
650
700
750
800
波長(nm)

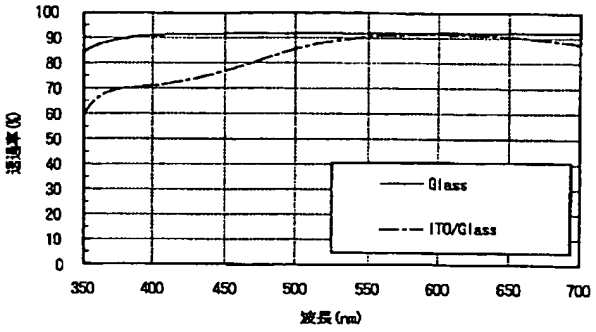
【図６】


21
32
30
31
33
24
22
25
23
35
G
R
B
G
R
34
B
29
26b
26a
27
27a
28
28
26

【図８】



【図９】



フロントページの続き

Ｆターム(参考)　5C027 BB04
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EG36 EH08